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ABSTRACT

Elementary and Secondary Education Act (ESEA) Title II funds were used in a 12-month project for the improvement of mathematics and science teaching at the prekindergarten through grade 12 levels in the Austin (Texas) Independent School District (AISD). The project provided: (1) staff development workshops; (2) consultants to develop a secondary scope and sequence; (3) funds for teachers to attend professional meetings; (4) materials; and (5) tuition and stipends for teachers to attend staff development workshops. In the 1989-90 school year, the AISD employed 1,835 elementary school teachers, 305 secondary school mathematics teachers, and 282 secondary school science teachers. Development workshops were evaluated through questionnaires completed by 116 participants (79 teachers, 28 administrators, and 9 other professional personnel), representing a response rate of 78%. High ratings were given to the instructional materials by the 171 teachers who completed questionnaires on their usefulness, although 5 elementary teachers of the gifted and talented commented that the materials were too advanced for their students. A major outcome was the coordinated scope and sequence developed for secondary mathematics beginning with grade 6, and a comparable scope and sequence developed for science in grades 8 and 10. Scopes and sequences for the other grades are to be developed over the next 5 years. Overall, Title II funds were used effectively to improve mathematics and science teaching in the AISD. The workshops were very well received by the participants, and all of the professional meetings were given high ratings. Teachers appraised elementary school and secondary school mathematics and secondary school science materials as useful/effective for improving instruction. Materials for instructing gifted/talented students received mixed reviews. Seven tables and 22 graphs are provided. (SLD)

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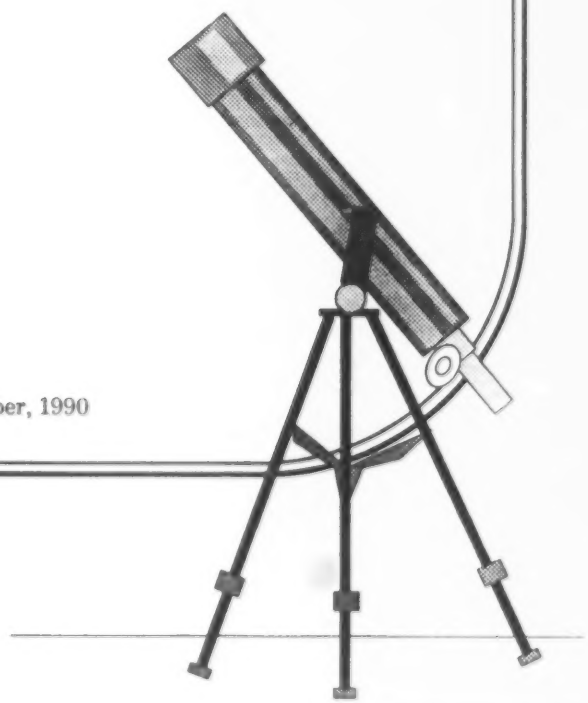
Focusing on Teachers:

ESEA Title II Mathematics and Science



September, 1990

TM015777

FOCUSING ON TEACHERS: ESEA TITLE II MATHEMATICS AND SCIENCE

EXECUTIVE SUMMARY

Author: Paula Marable

Program Description

Elementary and Secondary Education Act (ESEA) Title II funds were used in a 12-month project for the improvement of mathematics and science teaching in grades pre-K through 12. ESEA was designed to serve all 2,422 elementary and secondary mathematics and science teachers in the Austin Independent School District. In 1989-90, AISD received $108,000. In addition, $27,250 was rolled forward from 1988-89 (a grant total of $135,250). The project provided:

- Staff development workshops,
- Consultants to develop a secondary scope and sequence,
- Funds for teachers to attend professional meetings,
- Materials, and
- Tuition/stipends for teachers to attend staff development workshops.

Major Findings

1. Generally, most teachers rated the staff development workshops very positively (p. 4).
2. Elementary and secondary teachers gave instructional materials high ratings (p. 17).
3. Elementary Gifted and Talented teachers commented that materials received were too advanced for their students (p. 21).
4. Teachers who attended professional meetings rated them favorably (p. 23).
5. A coordinated scope and sequence was developed for secondary mathematics, grades 6 through 12 (p. 25).
6. A scope and sequence was developed for secondary science in grades 8 and 10 only. Scopes and sequences for grades 6, 7, 9, 11, and 12 will be developed over the next five years (p. 27).

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CONCLUSION

Overall, Title II funds were used effectively to improve mathematics and science teaching. The workshops, elementary and secondary, were very well received by the participants. All of the professional meetings were given high ratings. In addition, teachers appraised elementary and secondary mathematics and secondary science materials as useful and effective for improving instruction. Gifted and Talented materials were given mixed reviews. At this point (preimplementation), the secondary mathematics and science coordinated scopes and sequences seem to be comprehensive and functional, according to the mathematics and science instructional coordinators. Further study is recommended, especially of the scopes and sequences. At present, it can only be confirmed that the scopes and sequences were actually developed, but nothing of their implementation or efficacy can be determined.

INTRODUCTION

ESEA Title II was a 12-month project for the improvement of mathematics and science teaching in grades pre-K through 12. The project was designed to serve all elementary (grades pre-K-5) and secondary (grades 6-12) mathematics and science teachers. In the 1989-90 school year AISD employed 1,835 elementary teachers, 305 secondary mathematics teachers, and 282 secondary science teachers. From October, 1989 to September, 1990 $108,000 (plus $27,250 carried over from 1988-89) in Title II provided:

- Staff development workshops to acquaint teachers with the latest developments in instructional techniques and materials in their field,
- Consultants to develop a secondary scope and sequence to establish a formalized curriculum for mathematics and science throughout the District,
- Funds for teachers to attend professional meetings to provide for teacher involvement within their profession,
- Materials to accompany training in new methods of instruction,
- Tuition/stipends for science and mathematics teachers to attend staff development workshops (see Figure 1).

Figure 1 displays the elements of the 1989-90 Title II project by component. Project activities are described in detail in a later section of this report, "Description of Project Activities."

FIGURE 1
ELEMENTS OF ESEA TITLE II
1989-90

ESEA TITLE II COMPONENTS	Staff Development Workshops	Scope & Sequence	Attendance at Professional Meetings	Materials	Tuition/Stipends
Elementary Mathematics	X			X	X
Elementary Science	X			X	X
Elementary Gifted & Talented				X	X
Secondary Mathematics	X	X	X	X	X
Secondary Science	X	X	X	X	X

EVALUATION SUMMARY

The ESEA Title II evaluation focused on collecting, analyzing, and reporting information about the following.

A. Staff development workshops were offered to elementary and secondary mathematics and science teachers. Data were collected through:

   1. Interviews with AISD administrators and workshop coordinators, and

   2. Questionnaires distributed to teachers following every workshop.

B. Professional meetings were attended by selected secondary mathematics and science teachers. Data were collected through evaluations from the teachers who attended the meetings. Questionnaires were distributed to the teachers following the meetings.

C. New materials were received by elementary and secondary mathematics and science teachers. Evaluation questionnaires were distributed following each staff development workshop where teachers were able to participate in demonstrations of the new materials.

D. A scope and sequence was developed for secondary mathematics and another for secondary science. The scope and sequence components were examined, and data were collected through administrator interviews.

Because the major portion of the project activities occurred during the summer of 1990, and funds for evaluation were expended by September 30, 1990, the evaluation was primarily of the process type. Very limited outcome data were available about the effectiveness of the staff and curriculum development by the conclusion of the term of the funded evaluation. The ultimate impact of efforts to improve curricula, instructional materials, and teacher training in science and mathematics can only be ascertained over the long term, and then indirectly through the examination of global indicators of student achievement, which are influenced by a myriad of other factors.

WORKSHOP EVALUATIONS

Generally, all of the elementary and secondary mathematics and science workshops were given high ratings by the participants. Most comments from the teachers were positive also.

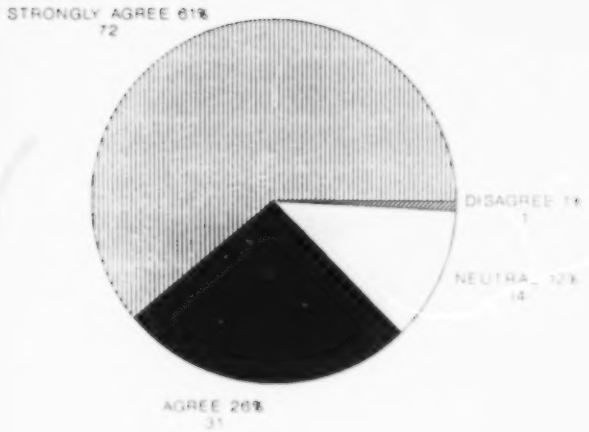
Elementary Mathematics

Title II provided six elementary mathematics workshops, which were attended by a total of 185 teachers. The two school year workshops which focused on unifix cubes and base 10 blocks attracted by far the most teachers; a total of 152 (82%) teachers (from all teachers who attended elementary mathematics workshops) participated. Different evaluation questionnaires were used with the unifix cubes and base 10 blocks workshops than with the other four summer workshops; consequently, their results are analyzed separately. Out of a possible 152, a total of 118 (78%) questionnaires were returned and analyzed, 79 (68%) by teachers, 28 (24%) by administrators, and 9 (8%) by respondents classifying themselves as "other." **Overall, the responses were quite positive**, with most respondents strongly agreeing or agreeing that:

- Interest was maintained (87%),
- Content was relevant/useful (94%), and
- Presenters were knowledgeable and well prepared (96%) (see Figure 2).

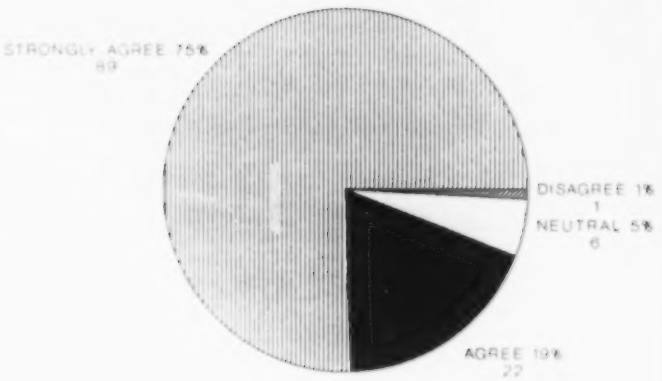
FIGURE 2
ELEMENTARY MATHEMATICS
WORKSHOP EVALUATION
1989-90

N = 118



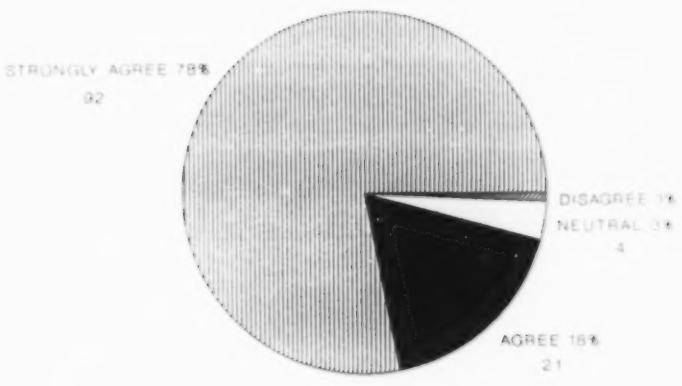
INTEREST WAS MAINTAINED.

N = 118



CONTENT WAS RELEVANT/USEFUL.

N = 118



PRESENTER WAS KNOWLEDGABLE
AND WELL PREPARED.

Questionnaires developed by the Office of Research and Evaluation (ORE) were distributed at the four summer workshops. Two of the workshops sponsored by Region XIII, "Mathematics Their Way, Part 2" and "Making Mathematics Memorable," were attended by many AISD teachers who were not funded through Title II. Of the 46 AISD teachers who participated in these workshops, 21 attended via Title II funds. Because the questionnaires are completed anonymously, there was no accurate way to distinguish the teachers whose attendance was funded by Title II from the other AISD teachers. Therefore, the questionnaires were analyzed altogether.

In the four workshops using ORE questionnaires, 52 (91%) were returned and analyzed. Most teachers responded very positively to all of the questions. Teachers strongly agreed or agreed that:

- The staff development workshops were beneficial and helpful (100%),
- Receiving this training would make them a better teachers of mathematics and/or science (100%), and
- Overall, they thought the training was worthwhile (100%) (see Figures 3 and 4).

FIGURE 3
ELEMENTARY MATHEMATICS
WORKSHOP EVALUATIONS
1989-90

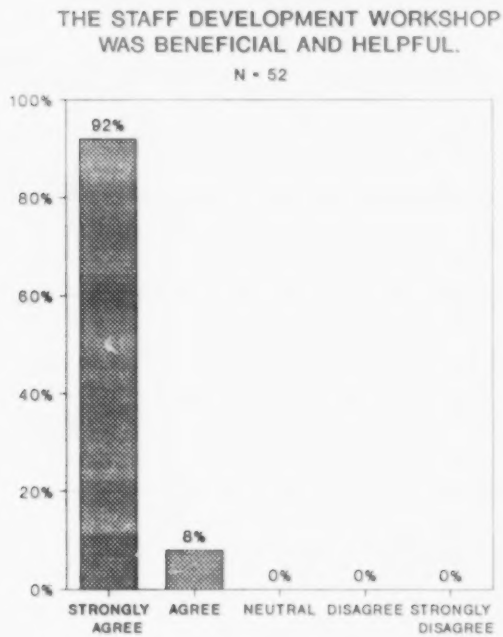
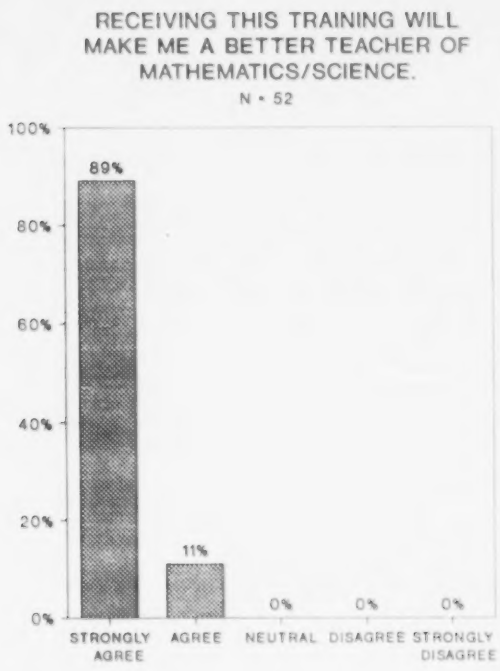
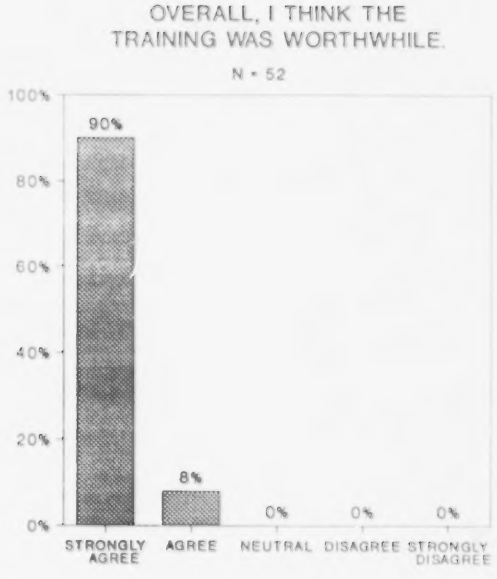


FIGURE 4
ELEMENTARY MATHEMATICS
WORKSHOP EVALUATIONS
1989-90





The comments from the questionnaires were mostly positive. The few negative comments centered around logistics: inconvenience of location, overcrowding of laboratories, and too much or too little time. Many elementary mathematics teachers asserted that students will have a greater understanding of concepts as a result of the new

instructional approaches, and they expressed support for the incorporation of manipulatives into their teaching. Teachers who attended "Mathematic Manipulatives, Part 1, Based on 'Math Their Way'" responded as follows to the question "Will this training change your instructional methods? If so, how?"

- Yes, by using manipulatives and taking more time with them.
- Yes, from a work-sheet based to manipulative based curriculum.
- Yes, I plan to implement most of their ideas.

Teachers attending the "Making Math Memorable" workshop responded to the question, "How will this training improve student achievement?" with these comments:

- Providing more multisensory activities will help the students to see the pattern or strategy more easily.
- Help them enjoy math more. With this enjoyment will come understanding.
- Hopefully a better and faster understanding of concepts--especially computation in order to spend more time in problem solving.
- I am more aware of what I should be teaching.

According to the Elementary Mathematics Instructional Coordinator, the workshops were successful. She observed improvement in mathematics teaching in the District from her classroom observations and expects to see more. She said that more than ever before teachers were interested in new instructional methods and especially manipulatives. Leaders from among the workshop participants emerged and informally have been appointed "mathematics expert" at their schools. Problems of the program, according the Instructional Coordinator, are that every school did not participate in the workshops (many schools did not have even one representative attend) and that some teachers would enroll in a workshop and then not attend.

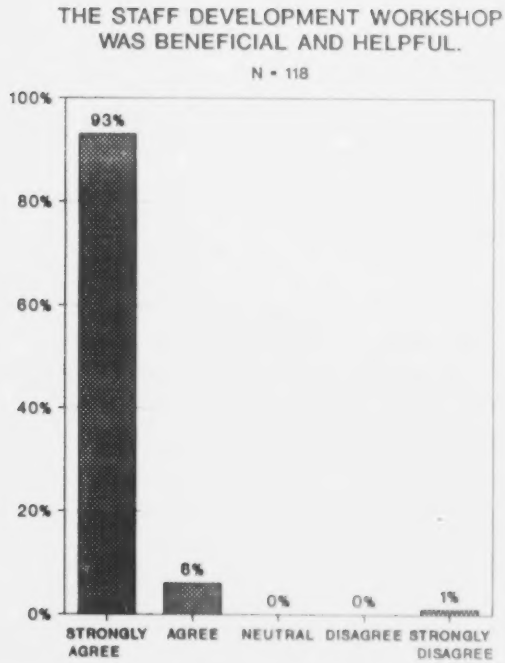
Elementary Science

Elementary science teachers were offered 10 summer workshops; a total of 138 teachers attended and 118 (86%) teachers turned in completed questionnaires. **Generally, teachers rated the workshops favorably. Some negative comments focused on workshop conditions** such as the

uncomfortable heat, lack of time, and too many activities. Elementary science teachers strongly agreed or agreed that:

- The staff development workshop was beneficial and helpful (99%),
- Receiving this training will make me a better teacher of mathematics and/or science (98%), and
- Overall, I think the training was worthwhile (97%) (see Figure 5 and 6).

FIGURE 5
ELEMENTARY SCIENCE
WORKSHOP EVALUATIONS
1989-90



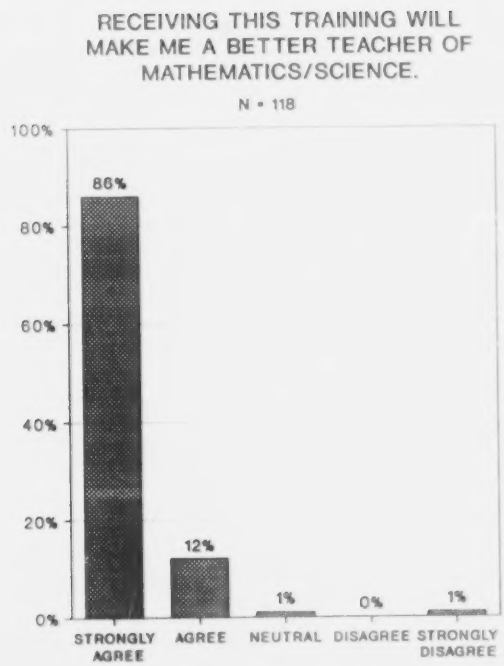
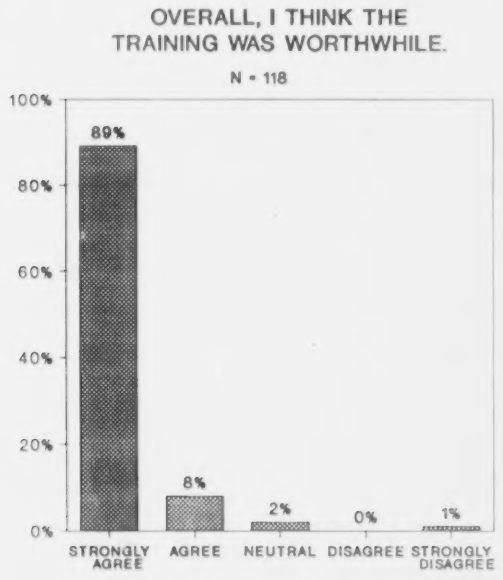


FIGURE 6
ELEMENTARY SCIENCE
WORKSHOP EVALUATIONS
1989-90



The comments from the questionnaires were mainly positive. In their comments, teachers showed enthusiasm for the exposure to new instructional methods and ideas. Responding to the question, "What did you like most about the training?" teachers from the "Energy, Forces, Motion, and Matter: Sixth Grade Physical Science" teachers commented:

- The analogies, comparisons, and applications to real life or current life situations were great!!
- Lots of ideas for activities; very well organized.
- The variety of subject covered, the freebies, the large amount of handouts with ideas and experiments, small class.

Teachers participating in the workshop "From Sky to Sea" responding to the question, "Will this training change your instructional methods? If so, how?" commented:

- Yes, I will incorporate science experiments weekly into my curriculum.

- The students will be engaged in more hands-on experiences and do more critical thinking and problem-solving.
- Yes, I will use more hands-on experiments to achieve goals in the classroom.
- Yes, I will do more cooperative learning with logical thinking.

The workshops were successful, according to the Elementary Science Instructional Coordinator; although she would prefer that more teachers participate. She said that science is usually not a favorite subject for elementary teachers; consequently, those teachers who did attend the workshops probably like science already and do not need the training as much as the teachers who dislike science. She believes that more teachers would participate if someone (like a principal) would encourage teachers to strengthen the subject areas in which they are the weakest.

Secondary Mathematics

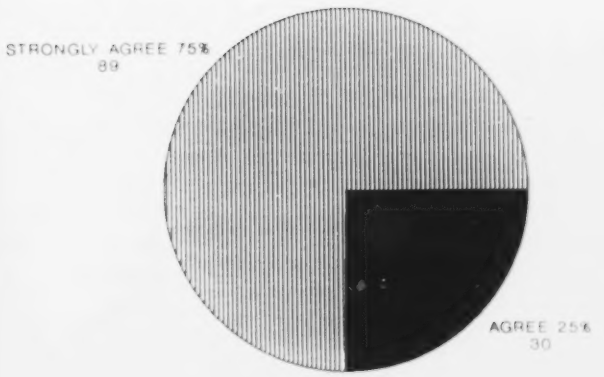
Secondary mathematics teachers were offered 16 summer workshops. A total of 160 (53%) teachers attended the workshops and 119 (74%) turned in completed questionnaires; among the respondents, 70 (60%) were middle school or junior high school teachers and 44 (38%) were high school teachers, and 2 (2%) classified themselves as "other." Altogether, 118 of the respondents were teachers and one was a teacher's aide. **Nearly all participants rated the workshops positively.** Teachers commented negatively about the excessive heat, not knowing about the workshops soon enough, poor facilities, and lack of time. Teachers strongly agreed and agreed that:

- The workshop was well organized (99%),
- The leader of the workshop was informed and insightful (100%), and
- The objectives of the workshop were clear (98%).

Figure 7 displays results from other questions.

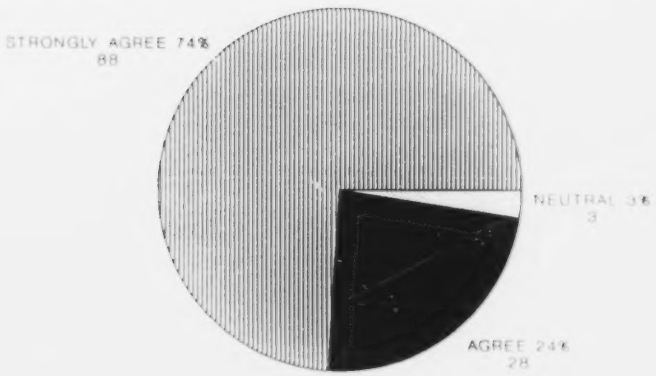
FIGURE 7
SECONDARY MATHEMATICS
WORKSHOP EVALUATIONS
1989-90

N = 119



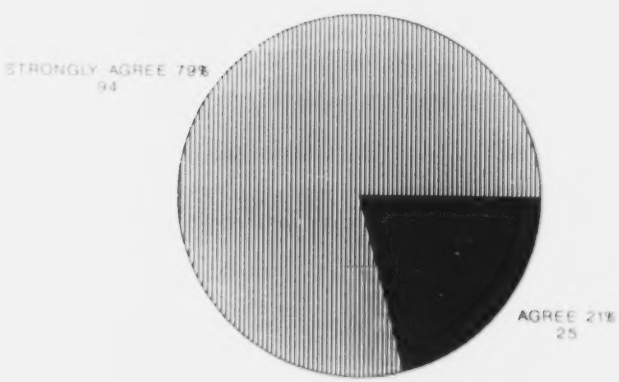
THE STAFF DEVELOPMENT WORKSHOP WAS BENEFICIAL AND HELPFUL.

N = 119



RECEIVING THIS TRAINING WILL MAKE ME A BETTER TEACHER OF MATHEMATICS/SCIENCE.

N = 119



OVERALL, I THINK THE TRAINING WAS WORTHWHILE.

Comments were very positive, with many teachers expressing their appreciation for manipulatives and the exchange of ideas with other teachers at the workshops. Some teachers from the "Problem Solving for Grades 7/8" workshop responding to the question, "What did you like most about the training?" commented:

- Sharing with other teachers.
- Sharing of ideas on how to teach objectives using manipulatives.
- I enjoyed sharing ideas and observing other teachers' styles.
- Learning new tricks from other teachers, watching other teachers teach, working with manipulatives.

Teachers were asked, "How will this training improve students' achievement?" Teachers from the "Factors and Multiples" workshops commented:

- It should enhance understanding and increase length of retention.
- Should enhance learning of [the] unmotivated student and challenge the advanced one.
- This training motivates the teacher to foster problem-solving at an abstract level in the classroom. In return, the student will master tne concept with deeper understanding.
- I think they will like the manipulatives and will grasp the subject better.

The Secondary Mathematics Instructional Coordinator believes at the workshops were successful. He said that teachers gained practical experience at their grade level. He added that teachers seem to prefer the longer workshops, three to five days, because they gain more hands-on knowledge and can take what they have learned in the workshops right into the classroom. Unfortunately, fewer teachers are served in the longer workshops because class size is limited. Shorter workshops can serve more people. One problem that occurred this year, according to the Secondary Mathematics Instructional Coordinator, was that Region XIII's summer workshop schedule was established one month before AISD's. Teachers committed themselves to Region XIII workshops, and because of scheduling conflicts, could not participate in the workshops offered by the District.

Secondary Science

Secondary Science offered a laser disk technology workshop in combination with an in-service meeting to develop a scope and sequence. A total of 37 teachers attended the laser disk technology/scope and sequence workshop; altogether, 24 (65%) questionnaires were returned and analyzed. Many teachers responded positively. Middle and high school teachers strongly agreed or agreed that:

- The staff development workshop was beneficial and helpful (100%)
- Receiving this training will make me a better teacher of mathematics and/or science (96%).
- Overall, I think the training was worthwhile (100%)

FIGURE 8
SECONDARY SCIENCE
WORKSHOP EVALUATION
1989-90

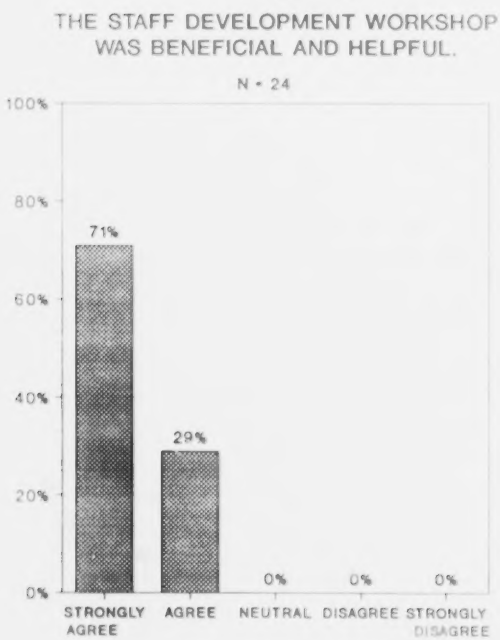
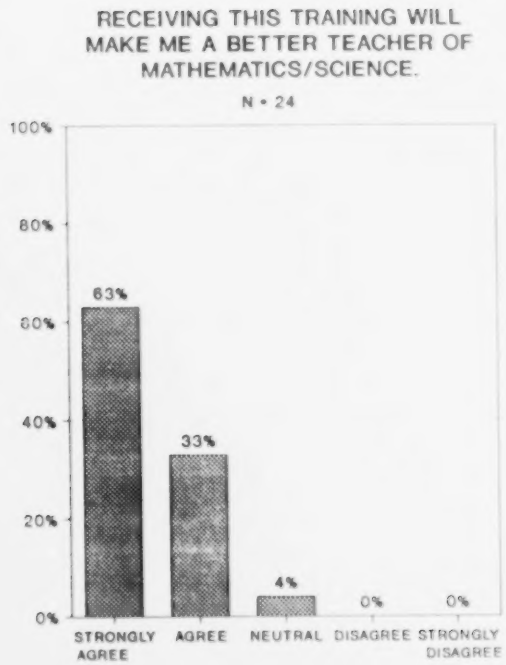
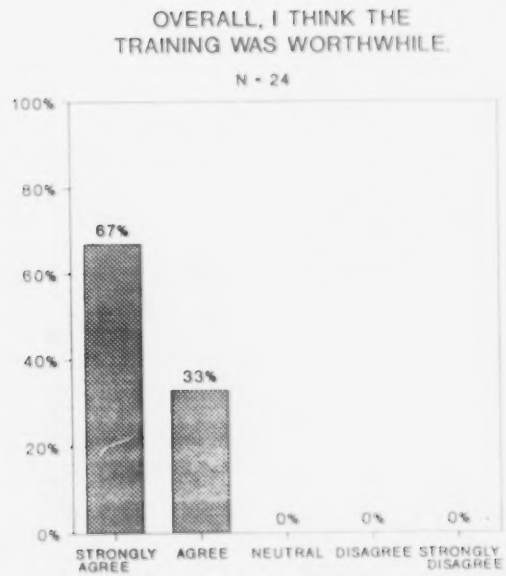


FIGURE 9
SECONDARY SCIENCE
WORKSHOP EVALUATION
1989-90





Comments from the teachers were mostly positive. Teachers responded enthusiastically to the laser disk technology. On the negative side, some teachers complained about not knowing the objectives of the workshop and what was needed to be accomplished. Answering the question, "How will this improve student achievement?" participants replied:

- Video presentation relate to excessive TV viewing done by many students.

- It allows the teacher to bring phenomena into the classroom that normally would not be possible (example, hurricanes).

- We are able to cite specific examples the students can see as we discuss them; make science related careers relevant and attainable.

Many teachers responded to the question, "How could this training be improved?":

- Confusion about writing process.

- We were unclear of our overall task in correlating curriculum and videodisc until the last day. We then felt rushed to finish it in the time left.

- The desired outcomes could have been pointed out at the beginning (of correlation with material).

According to the Secondary Science Instructional Coordinator, the workshop was very successful. He believes that "team-building" occurred through the sharing among teachers from different schools. The workshop strengthened curriculum by streamlining, cutting out useless facts and developing deeper concepts. Problems, according to the Instructional Coordinator, included lack of time, lack of materials, and not having all schools represented at the workshop; 4 out of the 25 middle and high schools were not present. He commented that he intended the scope and sequence in-service to be loosely structured, although many teachers complained of this. He said that he wanted to teachers to have an integral part in generating the scope and sequence; therefore, he did not have a set plan of action, but let it develop among the teachers. In addition, he said that he deliberately concentrated efforts in areas of need instead of trying to accomplish many different goals. He wanted more in-depth, less superficial concept improvements in the secondary science curriculum.

MATERIALS EVALUATIONS

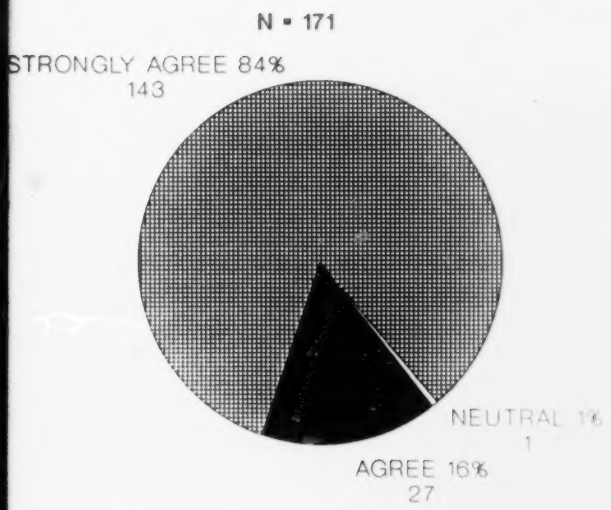
Elementary and Secondary Mathematics

Elementary and Secondary Mathematics purchased new instructional materials with Title II funds. Most of the items were purchased in the summer of 1990 to be used in the fall of 1990. Many of the workshops trained teachers to use the materials in the classroom, and the only exposure that teachers had to them prior to the evaluation is through the workshops. The questionnaires that teachers completed following each staff development workshop included questions about the materials presented. All of the opinions examined in elementary and secondary mathematics were formed with minimal exposure to the instructional materials and without using them in the classroom.

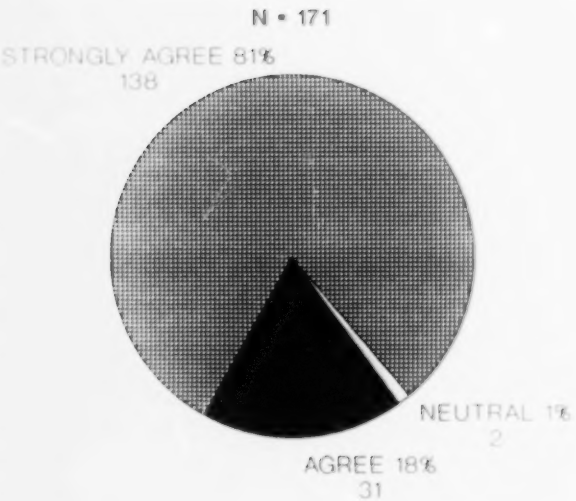
A total of 217 elementary and secondary mathematics teachers attended workshops which used the ORE developed questionnaires that asked participants about the materials presented. Altogether, 171 (79%) completed questionnaires. **Almost all teachers were very satisfied with the materials.** Most teachers strongly agreed or agreed that:

- The materials presented were compatible with the training given (99%).
- The materials were effective in improving mathematics/science instruction (99%) (see Figure 10).

FIGURE 10
ELEMENTARY AND SECONDARY MATHEMATICS
MATERIALS EVALUATIONS
1989-90



THE MATERIALS PRESENTED WERE COMPATIBLE WITH THE TRAINING GIVEN.



THE MATERIALS WERE EFFECTIVE IN IMPROVING MATHEMATICS/SCIENCE INSTRUCTION.

Commenting on the materials, elementary teachers participating in the "Mathematics Manipulatives, Part I, based on 'Math Their Way'" workshop responded:

- Hopefully, by using the manipulatives the students will be able to understand the meaning of numbers more fully.
- Students will be able to understand math concepts not just memorize facts and rules.

Secondary teachers participating in the "Factors and Multiples" workshop dealing with a section of The Michigan Middle Grades Math Project commented on the materials:

- I think these materials will be beneficial for preparing for the TAAS.
- Students will develop thinking skills needed to solve problems for themselves and retain the information longer.

Elementary Science

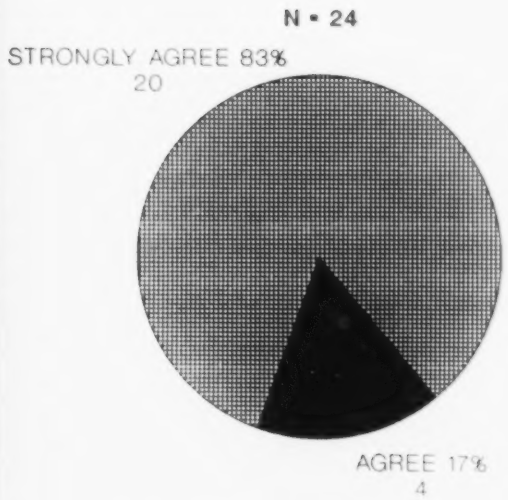
Elementary Science purchased all materials in the fall of 1989, these included five "Voyage of the Mimi" kits and five Apple computers by which to use the kits. The District has purchased and used other "Voyage of the Mimi" kits over the past five years. The materials were delivered to Priority Schools and second tier schools in January, 1990. The Elementary Science Instructional Coordinator said that the teachers were very pleased with the materials although, no training for using the kits and computers was given. A workshop is planned for the fall of 1990. Several teachers had previous exposure to the materials. Teacher evaluations of the kits were not collected, but they will be following the workshops in fall, 1990.

Secondary Science

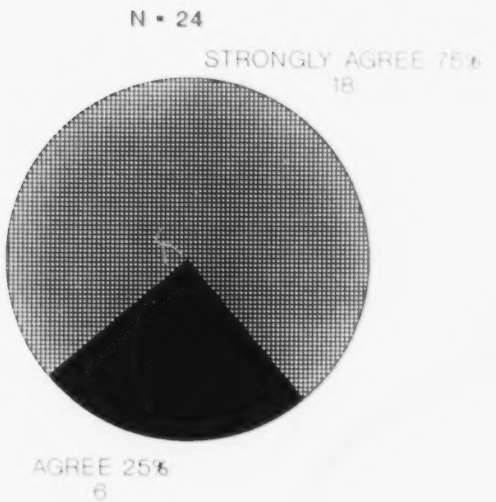
Secondary science purchased all of its materials in the summer of 1990. Surveys were distributed at the laser disk workshop which included questions about the materials. Altogether 37 teachers participated in the workshop; 24 (65%) questionnaires were returned and analyzed. Overall, **the participants rated the materials positively.** The teachers strongly agreed and agreed that:

- The materials presented were compatible with the training given (100%), and
- The materials were effective in improving mathematics/science instruction (100%) (see Figure 11).

FIGURE 11
SECONDARY SCIENCE
MATERIALS EVALUATIONS
1989-90



THE MATERIALS WERE EFFECTIVE IN IMPROVING MATHEMATICS/SCIENCE INSTRUCTION.



THE MATERIALS PRESENTED WERE COMPATIBLE WITH THE TRAINING GIVEN.

Comments related to the materials were very positive. Most teachers believe that the laser disk technology will facilitate understanding, especially for visual learners. Teachers commented on the laser disks with the following remarks:

- Visual images that remain on screen indefinitely will help students "picture" concepts that are difficult.

- Laser disks will get their attention better and help everyone see the same images.

- Gives students the opportunity to see experiments they would not have because too dangerous.

Elementary Gifted and Talented

Elementary Gifted and Talented teachers received questionnaires after they had used The Michigan Middle Grades Math Project in the classroom. The response rate was very low. Of 14 teachers who received the kits, five (36%) completed the questionnaire. All questions on the survey were open-ended. **Responses ranged from positive to negative.** Four of the five said that the kit was too advanced for their class: "Most of the time I had to gear it down to make the instructional part more simple for some of my students." Two of the five teachers saw improvement in the students'understanding and two did not. Teachers responding to the question, "How useful were the teaching plans and how appropriate were the lessons for your students?" offered:

- These materials were essential to the success of my lessons. Students got hands-on, exciting experience and really learned. The teaching plans and materials are a part of my curriculum. We constantly referred to our experiences throughout the year!

- Too, too, too high; although plans were clear. I took bits and pieces and incorporated them into my lessons.

With such a mixture of reactions and with so few teachers turning in completed questionnaires, the quality and usefulness of The Michigan Middle School Mathematics Project cannot be determined at this time.

PROFESSIONAL MEETINGS

In 1989-90, 38 secondary mathematics and science staff members attended professional meetings (the total includes 34 teachers, two elementary science administrators, one secondary mathematics administrator, and one secondary science administrator). See Figure 12 for the dates and locations of the conventions.

FIGURE 12
SECONDARY MATHEMATICS AND SCIENCE PROFESSIONAL MEETINGS
1989-90

Mathematics

National Council of Teachers of Mathematics (NCTM)
April 18-21, 1990
Salt Lake City, Utah

Conference for the Advancement of Math Teachers (CAMT)
August 7-9, 1990
Dallas, Texas

Science

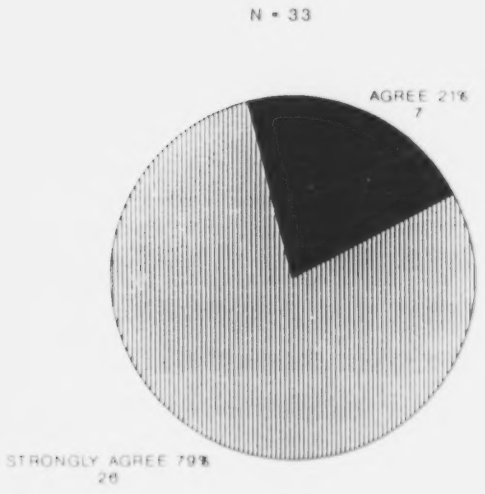
Conference for the Advancement of Science Teaching (CAST)
November 2-4, 1989
Waco, Texas

National Science Teachers Association (NSTA)
April 5-8, 1990
Atlanta, Georgia

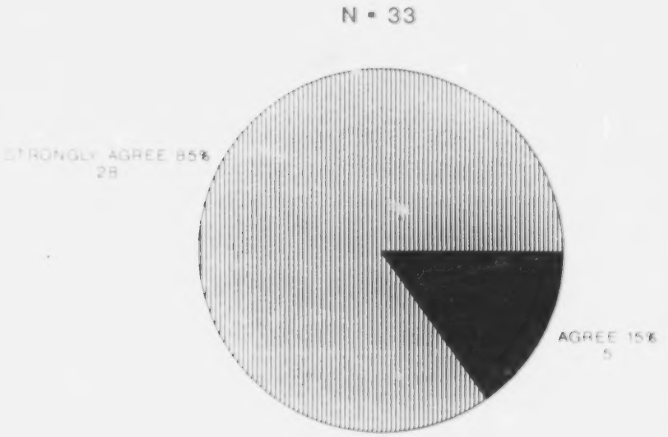
Following each meeting, the teachers completed a questionnaire to evaluate their experiences at the convention. Of the 38 teachers who attended the conventions, 33 (87%) turned in a completed questionnaire; Among respondents, 23 (70%) were science teachers and 10 (30%) were mathematics teachers. Altogether, 32 (97%) were

middle school, junior high, or high school teachers. The **teachers responded very favorably to the conventions** (see Figure 13).

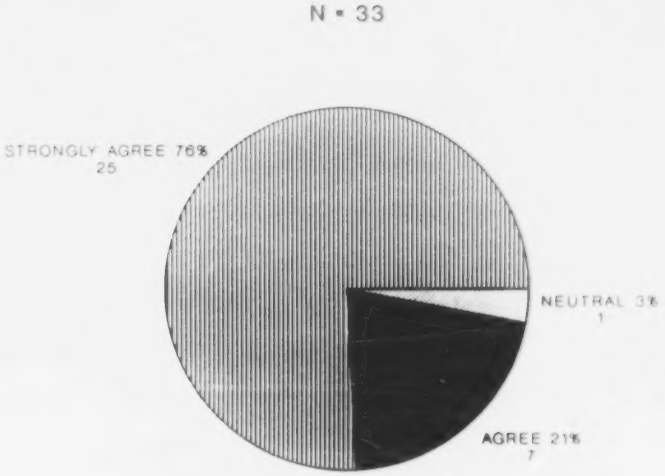
FIGURE 13
PROFESSIONAL MEETINGS:
SECONDARY SCIENCE AND MATHEMATICS
1989-90



THE PROFESSIONAL CONFERENCE WAS BENEFICIAL AND HELPFUL.



OVERALL, I THINK THIS CONFERENCE WAS WORTHWHILE.



ATTENDING THIS CONFERENCE WILL MAKE ME A BETTER TEACHER OF MATHEMATICS/SCIENCE BECAUSE I AM NOW MORE INFORMED OF THE CURRENT ADVANCEMENTS IN THE FIELD.

Although comments were not solicited, several teachers included remarks on their questionnaire.

- There was a lot of sharing of materials and ideas. I would love to go again. It helped tremendously.

- Several sessions filled early due to distance between rooms. Spacious rooms are needed.

- The AISD support of teachers going to CAMT of both long range and immediate benefit to the District. Teachers receive teaching strategies, content and technological information. I hope this support of CAMT and the national conference continues.

The 1989-90 school year was the first time AISD mathematics teachers could attend professional conventions all expenses paid. The Secondary Mathematics Instructional Coordinator regrets that more teachers could not participate. The Secondary Science Instructional Coordinator was pleased with the benefits that the conventions offered, and he too wished more teachers could be funded to attend the conventions. Teachers acquired new information and motivation and were able to form new contacts with teachers in different institutions within the nation.

SECONDARY SCOPE AND SEQUENCE

Mathematics

Secondary mathematics developed a scope and sequence for grades 6-12. A scope and sequence is a distribution of concepts by grades and subject matter strands (a cluster of topics). AISD needed a scope and sequence so that mathematics teachers, at all grade levels, can know how a concept was treated before their grade level, and how it should be treated at their grade level. The scope and sequence for secondary mathematics is intended to give every teacher an overview of all of the concepts on a given strand; it gives a picture of how content flows from grade to grade. Teachers at a particular grade level can refer to the scope and sequence and know how much school exposure a student has had to a topic prior to that grade.

The secondary mathematics scope and sequence was developed over a four week period by a committee of three teachers, one junior high and two senior high, chosen because of their expertise in mathematics and their knowledge of the curriculum in grades 6-12. **Altogether, 49 courses were examined concept by concept. The entire curriculum (49 courses) for grades 6-12 was broken down into nine subject matter strands:**

1. Numeration, computation, number theory
2. Patterns, functions, relations
3. Problem solving, applications
4. Geometry, coordinate geometry
5. Equations, inequalities
6. Measurement
7. Statistics, probability, data interpretation
8. Calculators, computers
9. Miscellaneous

The strands are curriculum objectives by which AISD mathematics teachers are to organize their instruction and are typical of most scopes and sequences. The nine strands are applied to each grade level, and each grade level will

apply the strands for that level of instruction (see Figure 14). The scope and sequence will continuously be amended as curriculum grows and changes.

FIGURE 14
SECONDARY MATHEMATICS
SCOPE AND SEQUENCE FOR GRADE 6 AND GRADE 6 HONORS

STRANDS	CONCEPTS
NUMERATION, COMPUTATION, NUMBER THEORY	Investigate history of numeration systems Read and write whole #'s, decimals, & fractions Round whole #'s and decimals Find relationship between fractions, decimals, percent & ratio Use factoring, primes, composites, lcm, greatest common factor (gcf) Use integers, place values, exponential notation +, -, x, -, whole #'s, fractions, decimals, integers Estimate with whole numbers and decimals Identify & perform operations with ratio & proportion
PATTERNS, FUNCTIONS, RELATIONS	Not applicable
PROBLEM SOLVING, APPLICATIONS	Select & match problem solving strategies to basic operations with whole #'s, fractions, decimals, or integers, geometric concepts, charts & graphs, units of measurements, probability &statistics, percent, personal finance
GEOMETRY, COORDINATE GEOMETRY	Use properties of 2- and 3- dimensional figures Find perimeter, circumference, area, surface area, volume Apply similarity, congruence, and symmetry Study translation, reflection, and rotation Acquire basic knowledge of number lines and coordinate planes Graph points on coordinate plane
EQUATIONS, INEQUALITIES	Use inverse operations Solve simple linear equations
MEASUREMENT	Use metric & customary measuring instruments Covert measurements within either system Perform basic operations with measurement units
STATISTICS, PROBABILITY, DATA INTERPRETATION	Collect and interpret data Interpret and construct charts and graphs Determine & interpret fractional probability Find averages
CALCULATORS, COMPUTERS	Apply use of calculators and computers to problem solving
MISCELLANEOUS	Not applicable

Topics are covered in more depth in the honors course.

The mathematics scope and sequence was designed to serve all mathematics teachers and their students. It will be introduced in November of 1990 at the chairpersons meeting, which is an assemblage of each mathematics department head from all AISD middle and high schools (one per school). Typically, the completed product is an enormous poster displaying the strands and concepts for each grade level. The secondary mathematics scope and sequence will be represented on loose-leaf paper in a ring binder which will make it more accessible to all teachers.

Science

Although originally planned to be developed for grades 6-12, the secondary science scope and sequence was developed for 8th-grade earth science and 10th-grade physical science only. A scope and sequence for other grades will be developed over the next five years. In AISD secondary science, a course sequence has already been established, although the scope is subject to change.

FIGURE 15
SECONDARY SCIENCE COURSES
1989-90

Required Courses for Grades 7-10

Grade 7	Life Science
Grade 8	Earth Science
Grade 9	Biology
Grade 10	Physical Science

Electives for Grades 11/12

Chemistry I/II
Physics I/II
Biology II
Geology
Astronomy
Marine Science
Environmental Science
Physiology

Because of the complexity of the task, the scope and sequence of two particular courses instead of all AISD science courses was developed for secondary science curriculum. According to the secondary science instructional coordinator, a scope and sequence for a given course provides the framework for which concepts will be taught during the school year. In addition, it suggests the sequence, and gives details of each concept. **The scope and sequence was developed to create a more uniform curriculum throughout the District in earth and physical science,** to **focus on audio/visual materials, and to streamline the curriculum.** In previous years, science teachers have had the problem of trying to teach too much material. The secondary science scope and sequence was introduced in September, 1990.

The 8th-grade earth science scope and sequence was developed by 20 AISD middle school teachers over a three day period in conjunction with a laserdisc technology workshop. The secondary science instructional coordinator sent a letter to each middle school to invite one or two teachers to participate. Teachers were chosen at each respective school by their interest and merit. The teachers received a stipend for their work. Following their development of the scope and sequence, the teachers returned to their school as trainers for the other 8th-grade teachers.

The 10th-grade physical science scope and sequence was developed by 20 high school teachers over a period of three days also in conjunction with a laserdisc workshop. The selection process was the same as with the 8th-grade teachers, based on interest and merit. The teachers received a stipend for their work. The teachers who developed the physical science scope and sequence returned to their schools to train the other 10th-grade teachers.

Basic course outlines were generated in correlation with the textbooks and videodiscs. The product will be illustrated in a loose-leaf notebook distributed to each 8th- and 10th-grade science teacher. Figure 16 presents a sample scope and sequence for 8th-grade earth science.

The secondary science instructional coordinator plans a meeting with the 8th- and 10th-grade teachers in late fall, 1990 to make sure that the scope and sequence is functional and useful.

FIGURE 16
SECONDARY SCIENCE SCOPE AND SEQUENCE (SAMPLE)

EARTH SCIENCE COURSE OUTLINE (8th Grade)

I. Physical Geology
- A. The Nature of Matter
  - 1. General Characteristics
    - a. Phases and transitions of matter
    - b. Physical vs. chemical properties and changes
  - 2. Atomic structure and introduction to the periodic table
- B. Materials of the crust: minerals and rocks
  - 1. Minerals
    - a. Characteristics and formation
    - b. Identification
    - c. Uses of minerals
  - 2. Rocks: igneous, sedimentary, and metamorphic
    - a. Igneous rocks: origin, composition, and classification
    - b. Sedimentary rocks: origin, composition, and classification
    - c. Metamorphic rocks: origin, composition, and classification
    - d. Common uses of igneous, sedimentary, and metamorphic rocks
- C. Structure of the earth
  - 1. Layers: core, mantle, crust, and moho
  - 2. Internal processes of change
    - a. Stress
      - 1. Faulting and folding
      - 2. Plateaus and domes
    - b. Isostasy
    - c. Seismic activity
      - 1. Earthquakes
        - a.) Wave action
        - b.) Detection
        - c.) Prediction
      - 2. Volcanoes
      - 3. Seismic zones
  - 3. Plate tectonics: the mechanism of continental drift
    - a. Continental drift: early evidence and contributions of Wegener
      - 1. Fossil remains
      - 2. Effects of glaciation
      - 3. Stratigraphic features of the continents
      - 4. Seafloor spreading
    - b. Plate tectonics theory
      - 1. Continental and oceanic plates
      - 2. Plate boundries
        - a.) Convection mechanisms (forces)
        - b.) Divergent and convergent boundaries
        - c.) Current plate motions
- D. Models of the earth
  - 1. Purposes of different types of maps
  - 2. Location: latitude and longitude
  - 3. Projections and distortion
  - 4. Topographic maps
    - a. Scales and legends
    - b. Elevation and relief
    - c. Making and interpreting a topographic map

II. Water resources
- A. Fresh water
  - 1. Water cycle
  - 2. Glaciers

(continued)

DESCRIPTION OF PROJECT ACTIVITIES

ELEMENTARY

Elementary Mathematics

The six elementary mathematics staff development workshops concentrated on teaching the use of manipulatives, or "hands-on" materials, such as unifix cubes and base 10 blocks. Most of the elementary mathematics workshops took place in the summer of 1990, although two transpired during the 1989-90 school year.

The workshops were organized by the AISD instructional coordinator responsible for the elementary mathematics curriculum. Elementary mathematics teachers were offered a total of six workshops, which ranged in length from one day to five days. The workshops were sponsored by Creative Publications, an educational publishing company based in Oaklawn, Illinois, and by Region XIII, the educational service center for Austin area schools. The workshops were held either in AISD schools or in Region XIII's five satellite locations in the Austin area. Many of the same teachers attended the workshops, with the greatest number of AISD teachers attending the workshops during the school year. The elementary instructional coordinator commented that teachers had to be encouraged to attend the summer workshops.

The leaders of the staff development workshops were consultants with Creative Publications who offered their services gratis, Region XIII consultants (a few of whom are teachers with AISD), and teachers in AISD (unaffiliated with Region XIII) deemed effective and knowledgeable about new ideas in the teaching of mathematics. Only about 15% of the mathematics consultants affiliated with Region XIII are also AISD teachers. According to the Region XIII mathematics coordinator, important criteria for becoming a consultant are experience and a history of being a good presenter. Seven different trainers led the six workshops with a team of two leading the workshop in the fall of 1989.

FIGURE 17
ELEMENTARY MATHEMATICS WORKSHOPS
1989-90

TITLE	DATE
Instructional Methods Using Unifix Manipulatives	November 14, 1989
Mathematics Manipulatives: Base 10 Blocks	March 27, 1990
Mathematics Manipulatives, Pt.1: Based on "Math Their Way"•	June 12-13, 1990•
Making Mathematics Memorable•	June 25-29, 1990
Mathematics Manipulatives, Pt.2 Based on "Math Their Way"•	August 9, 1990
Mathematics Problem Solving	August 14-15, 1990

• Sponsored by Regic.. .ill

Questionnaires were used for the workshop evaluations. Two different forms were utilized, an evaluation from Staff Development that is generally used following all workshops and an evaluation developed by ORE specifically for the mathematics and science workshops. The Staff Development evaluation form was used in two of the elementary mathematics workshops. The two questionnaires are similar in their questioning format; however, the ORE evaluation included more open-ended questions that solicited comments.

Elementary mathematics materials for the 1989-90 school year were purchased with ESEA funds carried over from the 1988-89 ESEA budget. Title II allows two years for funds to be

depleted. A total of $18,900 was spent on the new elementary mathematics materials, which included:

- Story problems with pattern blocks,
- Cooperative learning tapes and manuals,
- Test taking tactics, grades K-6,
- Primary cooperative problem solving series,
- Geoboard kits,
- Powers of 10 blocks,
- Special lessons, grades 1-6,
- "Arithmetic Developed Daily," grades 1-6,
- "Toad-ally Awesome Activities and Strategies for Math,"
- "Mathematics with Manipulatives," and
- Base 10 blocks for the overhead projector.

The materials are stored in the libraries at each school and are available to all elementary teachers.

Elementary Science

The 10 elementary science staff development workshops concentrated on teaching the use of manipulatives. In addition, the elementary science workshops offered training in Cooperative Learning Strategies (CLS), an instructional method that gives students special roles and responsibilities. All of the elementary science workshops occurred during the summer, 1990.

Elementary science teachers received staff development training in three areas:

1. Life Science: Grades 1 & 4
2. Physical Science: Grades 2 & 5
3. Earth Science: Grades 3 & 6

The workshops were organized by the AISD instructional coordinator responsible for the elementary science curriculum. Ten workshops with varying lengths of one to five days were offered to AISD elementary teachers. Teachers could attend as many workshops as they wished.

The workshops were sponsored by Region XIII, the educational service center, and the meetings were held at AISD campuses, mostly at Reagan High School. The leaders of the workshops were science consultants with Region XIII, many of whom are also teachers for AISD. At least 90% of the Region XIII consultants who led the science workshops are teachers in AISD schools. The teachers became consultants by referral from the elementary coordinator responsible for science, by volunteering, or Region XIII chose them because of their innovative and/or successful instructional methods

The workshops were requested by the AISD coordinator responsible for science curriculum. She informed Region XIII in advance on the focus of the 1990-91 curriculum and worked with the Region XIII science coordinator to make the workshops available for AISD elementary science teachers.

FIGURE 18
ELEMENTARY SCIENCE WORKSHOPS
SUMMER, 1990

TITLE	DATE
Up the Creek without a Textbook	June 12, 1990
Matter, Magnetism, & Electricity: 3rd-Grade Physical Science	June 11-12, 1990
Energy, Forces, Motion, & Matter: 6th-Grade Physical Science	June 14-15, 1990
Survival & Change: 4th-Grade Life Science	June 18-19, 1990
Staying Alive: 1st-Grade Life Science	June 21-22, 1990
Hands-On Science Activities for Kindergarten	June 25-27, 1990
Investigating the Austin Environment	June 28-29, 1990
Space: Our Next Frontier	July 30, 1990
Earth Science for 5th Grade	August 2-3, 1990
From Sky to Sea: 2nd-Grade Earth Science	August 2-3, 1990

(All Workshops Sponsored by Region XIII)

Region XIII did not sponsor a workshop to train fifth-grade teachers on the "Voyage of the Mimi" kit as was planned. The science instructional coordinator will schedule a workshop on this topic in the fall of 1990.

Elementary Science spent $11,300 in Title II funds for new instructional materials. The purchases included five Apple

II Classroom Color Systems and five "Voyage of the Mimi" kits with 35 Overview Guides.

Two elementary science administrators attended a national convention, the annual meeting of the National Science Teachers Association (NSTA).

Elementary Gifted and Talented

The elementary Gifted and Talented Program used Title II funds to provide learning materials for the schools' science clubs and to purchase The Michigan Middle Grades Mathematics Project for gifted and talented students.

The Gifted and Talented Program offered a Science Club at the elementary schools to provide "hands-on" science experience. Membership was based on interest in science. The meetings were conducted by classroom teachers who volunteered. Some teachers received a stipend for their work; others chose alternate means of compensation. According to elementary Gifted and Talented documents, there were 70 science clubs with 757 students and 76 teachers. (The numbers of science clubs and students are slightly higher, but because several teachers failed to turn in their records, those documented are the official numbers.) The meetings were held at each respective school. Six of the 16 Priority Schools maintained science clubs.

Within the Science Club was the Young Astronaut Council, a group which studies the adventures of astronauts. The Young Astronaut Council is a national program which local schools can join for a fee of $40 per year. Membership entitles the local clubs to receive monthly mail-outs which include curriculum packets and student materials. Students involved with the Young Astronaut Council study the planets, satellites, and telemetry and do flight simulations. In addition, the Young Astronaut Council offers courses titled "Shuttle Studies" and "Rocketry." There were two Young Astronaut Councils, one at Barton Hills Elementary and one at Patton Elementary, each led by one teacher. Sixty-one children participated.

The Gifted and Talented programs purchased The Michigan Middle Grades Mathematics Project, a collection of materials that will go beyond the subject matter currently taught in the elementary classroom. The Michigan Project, aimed at gifted and talented students in grades four, five, and six, will be piloted in 20 elementary schools. The materials include manipulative kits to accompany textbooks.

A total of 39 elementary teachers directly received benefits from Title II, either through stipends for leading Science Clubs or by receiving copies of The Michigan Middle Grades Mathematics Project kits.

SECONDARY

Secondary Mathematics

The secondary mathematics workshops concentrated on teaching the use of manipulatives and offered training in Cooperative Learning Strategies (CLS). The AISD secondary mathematics instructional coordinator organized the workshops. Sixteen workshops were offered to secondary mathematics teachers, 15 by the District and one by Region XIII. All workshops were held at AISD schools. A high percentage of teachers expressed interest in participating in the workshops. As a result, the secondary mathematics instructional coordinator had to turn away some teachers because of the need to limit enrollment in order to keep classes small. Participation was on a first-come, first-serve basis.

Leaders of the workshops were a Region XIII consultant and teachers in AISD deemed effective and knowledgeable about new ideas in the teaching of mathematics.

The workshops focused on the use of manipulatives at the junior high level and cooperative learning strategies at the senior high level. Manipulatives are designed to help teach students how to advance from concrete to abstract ideas, and cooperative learning techniques help students to work responsibly in groups. The first five workshops, Factors and Multiples, Similarity, Spatial Visualization, Probability, and Measurement examined topics in the Michigan Middle Grades Mathematics Project. Generally, the workshops concentrated on three essential elements required by the State that are not usually covered in text books:

1. Manipulatives
2. Calculators
3. Computers

FIGURE 19
SECONDARY MATHEMATICS WORKSHOPS
SUMMER, 1990

TITLE	DATE
Factors and Multiples	June 4, 1990
Similarity	June 5, 1990
Spatial Visualization	June 6, 1990
Probability	June 7, 1990
Measurement	June 8, 1990
Problem Solving, 7/8	June 18-22, 1990
Geometry Skills/Computation 6/7	June 20, 1990
Appleworks	June 20, 1990
Problem Solving, 6/7	June 25-29, 1990
Making Math Memorable*	June 25-29, 1990
Calculator Institute	August 2-4, 1990
Graphics Calculator	August 10, 1990
PreCalculus	August 14, 1990
Algebra	August 14, 1990
Geometry	August 15, 1990
Standards	August 16, 1990

* Sponsored by Region XIII

Secondary mathematics instructional materials were purchased with $6,700 in ESEA funds. Eighteen copies of The Michigan Middle School Mathematics Project, which includes instructional books and manipulative kits, were purchased for the middle schools. Other materials include:

- Texas Instruments (TI) Math Explorer Calculators
- Compute a Design: Whole Numbers, Decimals, Fractions, Percents
- Casio HS 8G Calculators
- TI 81 Graphics Calculators
- TI 34 TK Calculators

ORE-developed questionnaires were used for the workshop evaluations. Nine close-ended and six open-ended questions constituted the instrument.

During the 1989-90 school year, selected secondary mathematics teachers attended professional meetings. Interested teachers applied with Secondary Mathematics to attend the meetings. A committee, formed by the secondary mathematics instructional coordinator, selected teachers from the application pool. The teachers attended a national convention, the annual meeting of the National Council of Teachers of Mathematics (NCTM) and a state convention, the annual meeting of the Conference for the Advancement of Mathematics Teaching (CAMT).

A secondary mathematics scope and sequence was developed for grades 6-12 to organize formally the range and depth of topics in middle school, junior high, and high school mathematics. Teachers can refer to the scope and sequence and know how much school exposure a student has had to a topic prior to that grade. The scope and sequence was developed over a four week period by a committee of three AISD teachers, one junior high and two senior high, chosen for their expertise in mathematics and their knowledge of the curriculum in grades 6-12. The mathematics scope and sequence was designed to serve all mathematics teachers and their students. It is to be implemented in the fall of 1990.

Secondary Science

Secondary Science used Title II funds to offer a staff development workshop in laser disk technology in conjunction with the development of a scope and sequence. The workshop was organized by the AISD secondary science instructional coordinator and led by a representative from a laser videodisc company.

With $10,000 in Title II monies, secondary science materials were purchased; they included curriculum supplies for the scope and sequence, manipulatives for the training workshop, and laser disk software. Materials for the classroom include:

- Geology/Meteorology Multimedia Video disk Library
- Physical Science Multimedia Video disk Library

During the 1989-90 school year, secondary science teachers attended professional meetings. Science teachers attended a national convention, the annual meeting of the National Science Teachers Association (NSTA) and a state convention, the annual meeting of the Conference for the Advancement of Science Teaching (CAST).

89.45

Secondary Science developed a scope and sequence for 8th-grade earth science and 10th-grade physical science. The science scope and sequence was developed to create a more uniform curriculum throughout the District in earth and physical science, to focus on audio/visual materials, and to streamline curriculum. In previous years, AISD science teachers have had the problem of trying to teach too much material. Correlated with the textbooks and video disks, general course outlines were generated as well as overall goals for each course. The secondary science scope and sequence was implemented in September, 1990.

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